Journal of Geography and Regional Planning Vol. 5(6), pp. 173-188, 18 March, 2012
Available online at http://www.academicjournals.org/JGRP
DOI: 10.5897/JGRP11.101
ISSN 2070-1845 ©2012 Academic Journals

Full Length Research Paper

Geographical and longitudinal approach to rural livelihood security and crisis responses in Central Kenya: The case of crop variety and livestock breed selection

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Accepted 29 November, 2011

The study took a geographical and longitudinal approach as opposed to cross-sectional approach in detecting dynamic changes in livelihood strategies of smallholder farmers at two sites in Kabendera and Kiambogo, Central Kenya. The aim was to enhance the understanding of the ways in which households cope and adapt under increasingly evident and significant economic changes and agro-climatic events using the case of crop variety and livestock breed selection. It revealed that households engaged in various economic activities classified into five sectors namely: Agriculture, non-farm activities, livestock, forest product extraction, and off-farm activities. A partitioning of the households into four groups with reference to the sectoral composition of their annual net incomes revealed that all the four livelihood strategy clusters comparatively employed one dominant sector/activity with percentage contribution to annual net total income being above average and other sectors/activities playing a secondary role except for one cluster which is truly diversified. These were referred to as forest product extractors, non-farm activity entrepreneurs, diversified livestock keepers and agriculturists. The analysis of household's coping and adaptation experiences using crop variety and livestock breed selection brought to light a multiplicity of criteria upon which farmers based their decisions. These were grouped into six explanatory factors: Geographic-environmental, economic-commercial, administrative, agronomic, socio-cultural and historical. On the basis of these findings, the study argued for place-based analysis at both household-level and local-levels in enhancing understanding of local-level decisions in adoption of different livelihood strategies in the face of changing economic conditions and agro-climatic events. Even though the study is limited to the local scope, it can provide a basis for designing policies aimed at rural livelihood security improvement to inform and facilitate targeting of outside interventions such as food security programs which can be built on existing livelihood strategies.

Key words: Rural livelihood, coping strategies, economic liberalization, drought, Kenya.

INTRODUCTION

This study explored the issue of rural livelihood dynamism by contextualizing the theme of coping and adaptation process by smallholders (using the case of crop variety and livestock breed selection) within broader conceptual notions of livelihood diversification, vulnerability and resilience. The way in which livelihoods are composed under conditions of crisis, risk and uncertainty has received attention in the wider literature under the sustainable livelihoods approach (Scoones, 1998; Carney, 1998; Ellis, 2000). The approach provides a suitable framework for linking macro-level economic changes and agro-climatic events to specific effects on the household's livelihoods at the local level. Economic changes and agro- climatic events are macro-level processes intrinsically and fundamentally linked in shaping local level vulnerability and are manifested

particularly in rural agricultural areas of developing countries such as in sub-Saharan Africa. Despite this realization, the two processes have seldom been studied in conjunction. This study set out to bridge the macro-level variability of the two processes with local-level impacts by drawing from a detailed case study material of crop variety and livestock breed selection by smallholders in Central Kenya. In Kabendera and Kiambogo settlements, Central Kenya, smallholder farmers' vulnerability is inextricably linked to climate variability, natural resource base such as land availability and soil fertility, socio-economic trends and policy framework. Consequently, their livelihoods are not static but constantly dynamic in response to the changing conditions. Thus, the overriding question to the farmers and to which this study addressed was how to maintain or increase agricultural production under these variable and adverse conditions. A central theme of the study was therefore, coping and adaptive capacity and strategies among the smallholder farmers in Central Kenya in the context of economic and agro-climatic variability.

In order to fully understand the dynamic nature of livelihood strategies, it is required to take a longitudinal as opposed to cross-sectional approach of analysis into people's livelihoods. It is on this basis that this study took a longitudinal time-series perspective in an attempt to understand smallholder farmers' crop variety and livestock breed selection as a strategy to cope and adapt under increasingly evident and significant economic changes and agro-climatic events. In Central Kenya, farmers make decisions about crop choices at the beginning of every planting season which in most cases is a temporary response to either a familiar disturbance or transient threat such as a major drought or market price increase. From a longitudinal perspective, these short time-scale responses of crop selection within an existing agricultural production system gradually build into longer time-scale adaptation measures and adjustment of the livelihood system into forms of agriculture that moderate the negative impacts thus reducing the need for coping. The theme of crop and livestock selection directly relates to change in livelihood components and corresponds with broader conceptual notion of livelihood dynamism which is addressed in the wider literature but is rarely substantiated with empirical evidence especially in sub-Saharan Africa setting. Most studies are cross-sectional and lack a time-series perspective. A focus on monitoring changes in livelihoods through crop selection is both innovative and relevant themes in African smallholder dry land farming systems.

THE CASE OF CROP VARIETY AND LIVESTOCK BREED SELECTION

The choice of crop and livestock selection by smallholders as an important case of consideration in their coping and adaptive capacity can be explained in three accounts. First, it is a classic representation of just how economic liberalization interacts with climate variability to shape local vulnerability among small-holders. As noted earlier, however, this is a missing link in most previous studies particularly in African smallholder dryland farming systems. Eakin (2003) shows how smallholder farmers' adoption of irrigation and re-orientation towards vegetable production for the market, which on the face of it reduces farmers vulnerability to rainfall variability, may expose them to a different set of risks and costs, making them more vulnerable contrary to expectation. Liberalization has been observed to increase the need for cash, particularly to buy agricultural inputs such as improved/hybrid seeds, or fertilizer required for higher agricultural intensification which is in-turn shaped by the formal macro-level economy and trade. On the other hand, liberalization may make farmers more vulnerable by subjecting them to the volatile international market.

Secondly, the issue of crop and livestock selection defines the context that brings out the distinction between coping and adaptation clearly and can be operationalized using solid empirical data. Adgers' (1996) distinction is applicable in dryland farming systems in Central Kenya whereby farmers make decisions about crop choices at the beginning of every planting season which in most cases is a temporary response to either a familiar disturbance or transient threat such as a major drought or market price increase. From a longitudinal perspective, these short time-scale responses of crop selection within an existing agricultural production system gradually build into longer time-scale adaptation measures and adjustment of the livelihood system into forms of agriculture that moderate the negative impacts thus reducing the need for coping. The initial crop choices at the beginning of a planting season consequently lead to broader cropping patterns over time.

Thirdly, crop production may be improved by increasing cultivated area and/or increasing crop yields (Njie et al., 2006) but, increasing cropped area is checked by population growth and consequent diminishing of per capita availability of land, a situation which puts the smallholder farmers in a dilemma of increasing crop yields in a shrinking acreage of cropped area per capita. Through a screening and integration process of previously proposed adaptation options by Jallow (1995) among others, Njie et al. (2006: 7) identify crop breeding/selection, crop fertilization, and irrigation, as the most comprehensive, flexible agricultural intensification strategies to improve crop yields. The main argument in favor of crop breeding/selection is that of probable decline in rainfall and increased variability. On the other hand, promotion of crop fertilization as an adaptation strategy is influenced by continuous decrease in available prime land and concurrent degradation of arable land. Compared to other agricultural inputs, seed has been shown to have the greatest potential to increase on-farm

productivity and enhance food security needs for smallholder farmers in Kenya (Ayieko and Tschirley, 2006; Muyanga et al., 2005). This has become especially true of late as a result of global economic trends and associated market downturns, tariffs limiting market access, coupled with climatic variability. In Kenya, the agricultural liberalization has led to a liberalization of the seed and fertilizer sectors. These evolutions have led to an increase in the number of seed and fertilizer suppliers, particularly from the private sector, but also to a decrease in institutional support, in particular for research, extension, credit, and marketing (De Groote et al., 2005). In a review of Kenya's seed system, Ayieko and Tschirley (2006) notes that in recent years, a number of research, extension, rural development projects and non governmental organizations (NGOs) have all been involved in developing or disseminating varieties, producing or distributing seed. To a large extent, however, the benefits of these investments have failed to trickle down to the poor farmers and have been met with various challenges.

High cost of seed relative to other purchased inputs, coupled with the inability of the formal seed system to meet the demand by farmers, have been cited as bottlenecks to the seed industry (Nyoro and Ariga, 2004). Moreover, local and international seed companies find it unprofitable to make the investment required to provide the quantity, quality and variety of seed needed to support an expanding agricultural base. Seed companies concentrate in those crops where they can achieve higher profit margins in order to obtain competitive returns to their research and marketing investments (Ndjeunga, 2002).

Indeed, plant breeding programs by these seed companies often have not taken sufficient account of small scale farmers' interests and circumstances in crop variety selection, such as labor constraints, risk management and post-harvest preferences (Bett et al., 2000 as cited by Byerlee, 1994). According to De Groote et al. (2002), breeders usually select their material by analyzing large amounts of data, which are systematically obtained from highly controlled situations to reduce variability. Scientists like to control many factors so that they can accurately state that, under their very controlled circumstances, a limited number of traits have improved. These highly controlled circumstances are not often representative of farmers' conditions and the limited number of traits might not represent farmers' preferences.

This is reflected in a low uptake and differential adoption of new production technologies as revealed by various studies such as Toon et al. (1997), Ouma et al. (2002) and Hassan et al. (1998). But, as noted by Abebe et al. (2005: 22), 'farmers have the ability for selecting crop varieties to suit their environments and socio-economic situations.'

From these examples, it can be concluded that there exists a communication gap between scientists (breeders) and farmers as noted by De Groote et al. (2002) citing Kamara et al. (1996). However, efforts are being made to narrow this gap, in particular by a process called participatory plant breeding. In order to assure that new technologies fit farmers' needs and conditions, participatory methods are increasingly being applied to evaluate new technologies. The aim is to involve farmers more closely in variety development and selection, and therefore to increase the likelihood of adoption.

A notable contribution towards this endeavor is by Abebe et al. (2005) and De Groote et al. (2002) among others working under the auspices of International Maize and Wheat Improvement Centre (CIMMYT). The CIMMYT project developed and adapted participatory methods for identifying farmers' maize variety preferences in East Africa. Several methods used include: Breeding on-station under stress conditions (simulating farmers' conditions); participatory rural appraisals; farmers' evaluation of new varieties on-station, and mother baby trials (De Groote et al., 2002). As Ashby (1991) observes, it is assumed that such an approach allows for adoption and adaptation of the agricultural technology to suit farmers' own needs and environment. However, participatory methods are heavily influenced by group dynamics and consequently may present a distorted view of reality.

The complexity and variability of farmers' production strategies and objectives make it difficult to grasp farmers' selection criteria using a cross sectional (point in time) participatory approach. This realization calls for a longitudinal approach which crucially hinges on household-based investigation in understanding livelihood dynamism. Indeed, longitudinal livelihood-based approaches invite consideration of household-based investigation into the constraints and opportunities determining farmers' decision-making process in crop selection. Farmers select varieties based on small experiments and observations in the field and from anecdotal evidence, using intuitive multi-factor analysis (Sumberg and Okali, 1997 as cited by De Groote et al., 2002). The success or failure of agriculture in a household economy hinges on initial planting which is determined by farmers' ability to select crop varieties suitable to their own agro-ecological and broader socio-economic conditions.

Several studies have identified various important criteria of crop variety selection. Crop choice is frequently mentioned in the adaptation literature as a potential adaptation strategy to climate change. For example, Kurukulasuriya and Mendelsohn (2007) estimate the climate sensitivity of specific crop choices made by farmers in Africa by examining the crop choices that those farmers make across different agro-ecological zones. The analysis centers on how farmers in different climate zones have adapted to current climate. Barkley and Porter (1996) found that choosing a variety in Wheat in Kansas, U.S.A is strongly responsive to past production decisions and relative yield, as well as significantly related to variety age and yield stability. Rost

and Walther (1997) elucidated the importance of variety selection according to market situation and site conditions in Holland. They demonstrated economic rationality in crop selection through grower's consideration of higher production output. These studies amongst others (Scoones et al., 1996) indicate that farmers make crop selections based on several criteria, including available inputs such as labor (both hired and house- hold), experience, availability of seed, prices, government policy and a host of environmental factors, for example, climatic, soil conditions and available surface flow of water.

Detlefsen and Jensen's (2004) contribution of a stochastic model for crop variety selection that finds the optimal variety with respect to several characteristics is valuable in elucidating the issue of crop choice from the farmer's perspective and its emphasis on the dynamics in the decision process, even though its scope is limited to consideration of future uncertain observations and decisions by farmers.

But Scoones et al. (1996) working from a different geographical setting in sub-Saharan Africa arrive at opposite conclusion, that as result of the immense range of influences on crop choice, simple decision models that try to describe such detail will almost inevitably fail due to specification problems since so many factors are influential, thus there can neither be optimal crop choice or combination nor standard prescrip- tions for an area characterized by variability of environ- ment and economic conditions such as Africa's dry lands. Instead, a more direct assessment of farmer's own perception of decision trade-offs using their own criterion is more illuminating. It is worth noting that Detlefsen and Jensen (2004) are aware of this fact as noted in their model assumptions and limitations with regard to variations brought about by seasons and locality.

The current study seeks to contribute to this body of knowledge and enhances our understanding of crop and livestock selection in the context of variability and fluctuation of economic and environmental conditions by employing a longitudinal (and dynamic) approach which crucially hinges on a historical perspective and farmers' perceptions of crop variety attributes. This is in an attempt to understand how farmers maintain or increase agricultural production and how constraints and opportunities shape variations in decision-making process of crop selection among households and over time as a coping and adaptation strategy. To the best of my knowledge, there are no studies that examine determinants of farmers' decision-making process under changing economic conditions and agro-climatic events in a longitudinal manner.

METHODOLOGY

Research questions

The overriding question to the farmers and to which this study addressed is on how to maintain or increase agricultural production under variable and adverse conditions of economic change and agro-climatic events, and on how constraints and opportunities shape variations in decision-making process of crop selection among households and over time as a coping and adaptation strategy. The overall objective of the study was detection of dynamic changes in livelihood strategies through understanding the ways in which households copes and adapt under increasingly evident and significant economic changes and agro-climatic events using the case of crop variety and livestock breed selection. Specific research questions were:

1. What are the socio-economic characteristics of the study sites and selected households?
2. What are the household livelihood components/activities and their relative importance in the production aspect of the household economy?
3. How do households combine different livelihood components/activities and what are the resultant livelihood strategies and areal differences in the strategies between the two sites?
4. What are the types and patterns of smallholder farmer's crop variety and livestock breed selection as a case of household's crisis-coping experiences and responses?

Conceptual framework

The conceptual and analytical framework of analysis advanced for understanding the problem under investigation and thus the innovative aspect of the research was premised on the Livelihood-Crisis twin pronged approach, that is, the detection of dynamic changes in livelihood strategies through understanding the ways in which households cope and adapt under conditions of crises, risk and uncertainty using the case of crop variety and livestock breed selection. While the individual is the prevailing unit of analysis, the research took households as analytical frame of reference in investigating the themes embodied in the twin pronged approach.

Theme 1: Livelihoods; concerned an assessment of household livelihood components and their combination strategies through annual net total income estimation and assets.

Theme 2: Crisis, focused on household vulnerability in terms of crisis-coping experiences and went further to examine crisis events objectively and longitudinally using the case of crop variety and livestock breed selection to identify adaptive strategies.

Finally, the study dealt with the issue of operationalizing the concept of livelihood strategies with quantitative household-level data and how then to use the identified strategies to test the livelihood-crisis nexus, that is, the matching of discernible livelihood strategies with the patterns of crop variety and livestock breed selection/de-selection..

Data collection: Household and field surveys

The study drew from field survey data informed by geographical and longitudinal methodology of approach. Judicious mix of a qualitative component addressing the social and institutional context of people's lives and a quantitative component addressing assets, activities, incomes as well as coping and adaptation aspects at the household level was used during the research. Data collection was done using a range of techniques to generate a wide variety of information on each of the two themes in the livelihood-crisis nexus.

The household-level questionnaire was designed to provide information on the socio-economic aspects of the households in

order to assess average livelihood components and strategies through an estimation of annual net total income. Data on the crisis-coping element was acquired through information gathering on crisis events objectively and longitudinally using the case of crop variety and livestock breed selection. A variety of key informant interviews were conducted with village leaders, older people and Government staff as part of information gathering on general issues such as migration and settlement history and process, agro-ecological events among others.

Statistical methods of data analysis

Drawing from a case study material of 40 households and two data sets addressing the two themes embodied in the livelihood-crisis nexus approach, the main issue which the study dealt with is that of operationalizing the concept of livelihood strategies with quantitative household-level data and how then to use the identified strategies to test the livelihood-crisis nexus, that is, interpreting livelihood strategies not only by net income composition and assets, but also by the historical experience of crop variety and livestock breed selection/de-selection. Both geographical and longitudinal data analysis techniques were used. It should be noted that the longitudinal technique was applied on the crop and livestock selection sequence but not on livelihood strategies. The major concern with this approach was on mismatch of time since crop and livestock selection as a case of crisis/shock element of the nexus may be experienced over a period of time not coinciding with the annual income estimation period. This realization made it prudent to employ conceptually related approach of asset endowment that is assumed to record the past experience of income accumulation. A geographic analysis based on areal and/or spatial differentiation at both macro and micro levels was used to contextualize site level information within the national and regional broad patterns and variation in space.

Socio-economic characteristics of selected households and study sites

An investigation of the nature and character of the interviewed households and the study sites in terms of their socio-economic characteristics was deemed necessary to set the base for discussing other components of the research. Thus, an analysis of age and education of the household head, household size, asset ownership (land and livestock) as well as housing amenities was attempted.

Household livelihood strategies, socio-economic stratification, and crisis-coping

In this study, both realized annual net total income estimate and asset-based approaches were used in analyzing household livelihood strategies. Annual net total income was defined as gross production less all total variable costs including hired labor, farm implements, fertilizer, seeds, pesticides etc. Thus, the total annual net income (covering one year period prior to the survey) was calculated by subtracting monetary costs (household labor excluded due to difficulties of accurate measurement) from the value of total production, which is evaluated on average market prices of the relevant products for each site; similar approach is given in Ueda (2007). On the other hand, the asset-based approach was employed to estimate household asset endowment. Two indicators of household asset endowment were thus used, that is, land and livestock ownership.

An investigation of the nature and character of the interviewed households in terms of their socio-economic characteristics, livelihood strategies, and crisis-coping experiences was attempted, with special attention to their comparative net income portfolios. The aim was to measure the relative importance of livelihood components/activities to the household economy, identify the areal differentiation of livelihood strategies and examine the relationship between net income levels, assets and socio-economic status on one hand, and livelihood strategies with crisis-coping experiences on the other hand, indicating relatively successful livelihood strategies in different geographical settings.

Five indicators of socio-economic status differentiation were used to achieve this aim. These are annual net income flow, land endowment, livestock ownership, and age of the household head. The information on net income and asset ownership was used as a basis for stratification of the selected households.

Crop variety and livestock breed selection: A longitudinal approach

To better understand farmers' experience of coping and adaptation and the constraints and opportunities that shape variations in their decision-making process of crop variety and livestock breed selection as the important case of coping and adaptation strategy, this study investigated in a longitudinal manner farmers' decision-making geared towards maintaining or increasing agricultural production. It employed a longitudinal approach in an attempt to identify smallholder farmers' criteria of crop variety and livestock breed selection. As such, it used the farmers' experience of coping/adaptation to answer the fundamental question of how to maintain or increase agricultural production under variable and adverse conditions by households and over time.

The study draws from a survey conducted to collect longitudinal time-series (sequential) data on crop variety and livestock breed selection and de-selection into and out of farm fields of the 40 households in the two research sites of Kabendera and Kiambogo. First the farmers were asked about the crop varieties and livestock breeds they have ever selected and de-selected into and out of their farm fields as well as the selection criteria in a longitudinal manner since their settlement. Second the farmers were provided with a list of the crop varieties and livestock breed, and criteria of selection or special attributes that were aggregated from the first stage of field work, and were asked to specify their level of agreement to a statement about the criteria of selection. These were presented using a five-point Likert Scale and farmers evaluated and/or perceived them on a 1 (strongly agree) to 5 (strongly disagree) response scale.

The choice of study area: northeastern slopes of Aberdare Ranges, Nyeri North District

The study area is located in the former Nyeri District, Central Province, which comprises the most western part of the moist windward side of Mt. Kenya (5199 m), the drier western leeward side of this extinct volcano, the borders of the semi-arid Laikipia Plateau (in the rain shadow area), and the moist windward eastern slope of the Aberdare range (4000 m).

The inhabited areas in the District consist of two distinct blocks conforming to the newly created districts, the traditionally Kikuyu south (Mathira, Mukurweini, Othaya, Tetu Divisions, and Nyeri Municipality) and the north formerly in the scheduled areas (Kieni East and Kieni West Divisions).

The southern half is former African reserves, densely populated and fertile, with homesteads of Kikuyu, while the northern half is part of the former scheduled areas for white settlers which have been subdivided to African smallholders under settlement schemes in the 1960s (Ueda, 1999). The new frontier areas attracted the migrating land poor Kikuyus from the traditional birth places in the

south. In these new frontier areas, Sottas (1992) researching under the auspices of Laikipia Research Programme, observed that unfavorable ecological and economic conditions create contradictions and many households undergo a considerable risk to fall into marginality. Yet, these areas remain largely un-researched.

Within Nyeri North District, Northeastern slopes of Aberdare Ranges were chosen as study area on several accounts. Based on the historical mosaic bequeathed from the colonial and post colonial period, the area was an open frontier for African settlement with both government settlement scheme known as Watuka and private land-buying company, Gatarakwa, being key players in land subdivision and allocation. Consequently, the area witnessed an influx of migrants from the densely populated high-potential areas of Central Kenya.

In order to understand the influence of local agro-ecological settings on household livelihood strategies, it was deemed necessary to undertake a comparative case study approach. An ingredient of such an approach is local level areal differences arising from ecological gradients, such as found on mountain slopes, which provide examples of a variety of farming and economic systems in a small area, and often are characterized by interactions between the slope zones (Ueda, 2007; Kiteme et al., 1998 and Majule et al., 2004).

Northeastern slope of Aberdare Ranges constituting forest adjacent communities of smallholder households encompass such diversity and was thus chosen as the study area. The differences range from the upper/higher elevations being cool and very humid yielding greater and more reliable rains and more moderate temperatures to the hot, semi-arid savannah at the lower slopes. These local-level elevation differences give rise to household livelihood differences with high elevations supporting agricultural-based economy. On the other hand, households might struggle at lower elevations, eking out a bare subsistence straddling different livelihood activities.

The comparative case study approach used in this research allowed these general postulations to be substantiated and confirmed at both household and local (geography) levels. Within Northeastern Slopes of Aberdare Ranges, the study focused on two contrasting research sites in the micro study area, Kamariki Sub-location (Table 1 and Map 1).

The area is broadly a mix representative of the conditions found in the wetter and drier parts of Nyeri North District. The case study sites are representative of the diverse range of ecological conditions, topographical settings, vegetation associations and soil types prevalent in the district. The two sites were: Kabendera located at lower to intermediate zones of Northeastern slopes of Aberdare Ranges adjacent to South Laikipia Forest Reserve and the wetter Kiambogo on the higher elevations of Aberdare Ranges next to Aberdare Forest Reserve. Located in a continuous slope, the two sites were chosen for detailed survey to facilitate comparative case study approach owing to their location in different agro-ecological zones within the study area as well as different settlement history. Such an approach was deemed necessary to enhance understanding of the functioning of the regional system within which the two sites are located.

RESULTS

Socio-economic characteristics of selected households and study sites

The most salient average socio-economic characteristics of the research sites referring to all members and heads head, household size and adult equivalent units (AEU) indicate that Kabendera households are older, more educated, have larger family size and active labor force. Of the selected households as revealed by the survey are presented in Table 2. These are in form of frequencies, mean values and percentages. On average, the mean values of age and years of education of the household head, household size and adult equivalent units (AEU) indicate that Kabendera households are older, more educated, have larger family size and active labour force.

Kabendera households also have more livestock value per capita (Kshs 15,171) than those in Kiambogo (Kshs 11,105). On the other hand, Kiambogo farms more area per capita (0.8 acres) and its agricultural sector contribution to annual net income is considerably greater than that of Kabendera (0.5 acres). As for the physical structures of dwellings units, an examination of the mean values of age and estimate value of the main house shows that houses in Kabendera are older (11.5 years) and of higher value (Kshs 215,000) compared to Kiambogo (9.4 years and Kshs 178,000) respectively.

In terms of housing conditions and amenities, the dominant roofing, wall, and floor materials are corrugated iron sheets, wooden, and earth respectively for both of the sites. Use of firewood for cooking, charcoal for heating, and paraffin as lighting fuel is prevalent. Kabendera residents rely more on river/stream (50%) as source of water while their counterparts in Kiambogo depend on borehole (45%). In the recent past especially starting 2008, most households in both sites have started to use piped water from the Gataragwa/ Mugunda Water and Sanitation Project funded by World Bank and International Fund for Agricultural Development (IFAD).

Household livelihood strategies, socio-economic stratification, and crisis-coping

An analysis of the activity dimension of the livelihood was attempted by construction of income portfolios for the households. The production aspect of household economy was classified into five activity sectors from the survey data. The results revealed the order of importance (in terms of aggregate income portfolios) of the five sectors to be agriculture, non-farm activities, livestock, forest product extraction and off-farm activities (Table 3). The composition of annual net income by sector indicated Kiambogo leading in agricultural, forest products extraction as well as off-farm activities while Kabendera was highly depended on non-farm activities, agricultural, and forest product extraction in that order.

The study also employed cluster analysis techniques to operationalize the concept of livelihood strategies using household level data and showed how households choose and combine options across the five different sectors of activities already identified. In particular, the 40 households were partitioned into statistically distinct groups with reference to the sectoral composition (in percentage) of their annual net total incomes. The sectoral composition in percentage of each activity constituting the annual net total income is presented in

Table 1. Households and household size, area in Sq. km and density by administrative levels[1]

National	Province	District	Division	Location	Sub-location/ Village	Households	Population	Area (km²)	Density
Republic of Kenya						6,371,370	28,686,607	581,677	49
8 Provinces of which	**Central Province**					924,545	3,724,159	13,220	282
	7 Districts of which	**Nyeri District**				168,786	661,156	3,356	197
		7 Divisions of which	**Kieni West Division**			16,699	68,461	626	109
			5 Locations of which	**Gataragwa location**		3,809	16,310	213	77
				4 Sub-locations of which	**Kamariki Sub-lo**	1,647	6,740	89	59
Central					Githura A	121	510		
Nairobi					Kandigiri	61	261		
Coast	Nyeri	Kieni West			Githura B	109	481		
Eastern	Kiambu	Kieni East			Kiambogo	166	734		
North Eastern	Kirinyaga	Mathira			Kiboya	89	344		
Nyanza	Murang'a	Mukurwe-ini	Gataragwa		Bellevue B	217	780		
Rift Valley	Nyandarua	Othaya	Mwiyogo	Kamariki	Bellevue A	175	528	Information	
Western	Thika	Tetu	Mweiga	Watuka	Kabendera[2]	32	101	not available	
	Maragua	Municipality	Endarasha	Lamuria	Wamucuni[2]	82	319		
			Mugunda	Embaringo	Kaheho A	114	450		
					Kaheho B	116	506		
					Gacuma	118	519		
					Birisha	90	377		
					Secondary line	157	830		

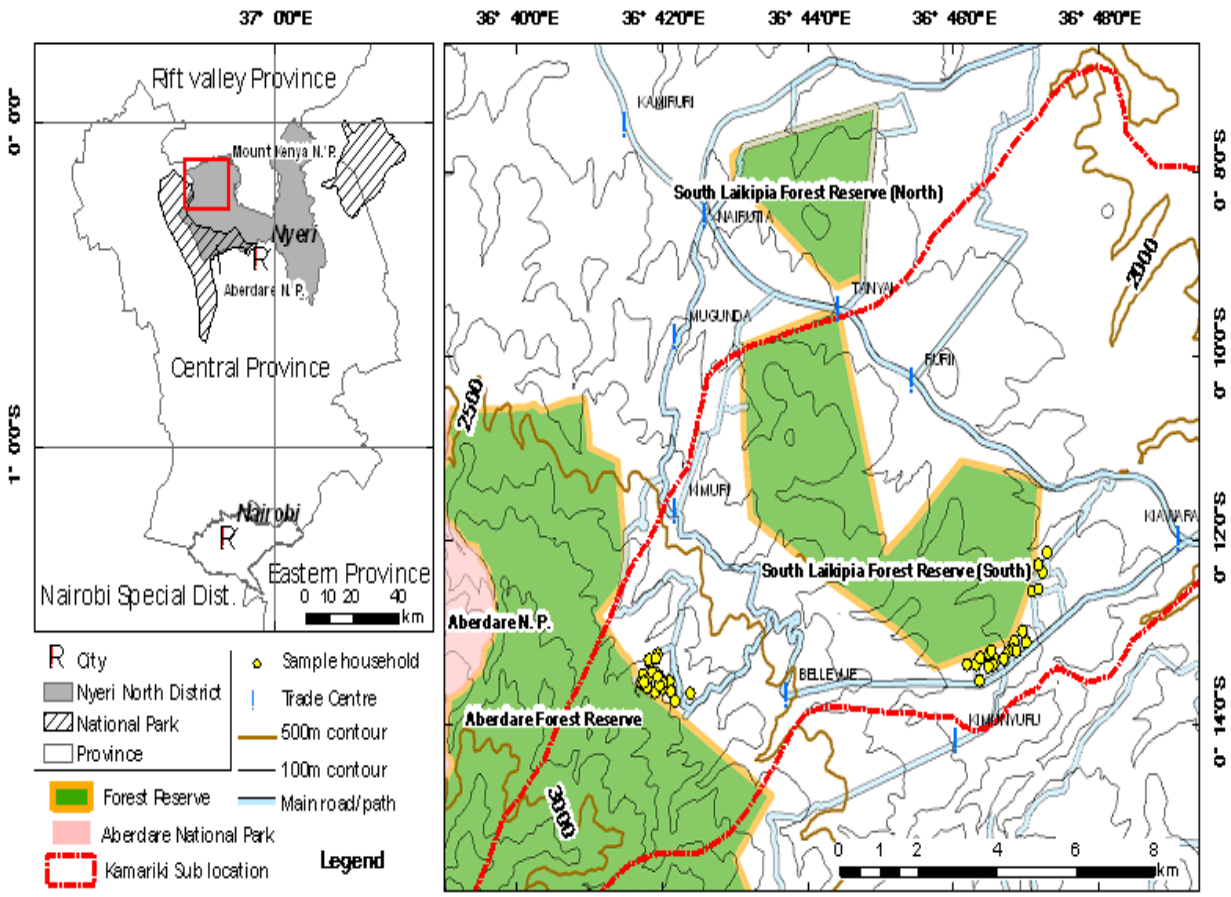
Source: Kenya, Republic of (2001): The 1999 Population and Housing Census, Volume 1, Nairobi, Central Bureau of Statistics. Notes: 1. There have been changes in boundaries due to creation of new districts, divisions, locations and sub-locations since 1999. 2. The term 'Village' is used to refer to Central Bureau of Statistics' Enumerated Area (EA) – a statistical unit of enumeration which according to 1999 census was expected to contain 100 households. The boundary of an EA was delineated using identifiable features like roads, rivers, footpaths etc. From the previous definition, of a Village and/or EA, the boundaries of the two study sites are not clear cut and can be said to lie in Kiambogo, Kabendera and Wamucuni villages.

Table 4 (Part A). Part B of Table 4 contains a cross-tabulation of cluster membership by site and income. Other variables examined by include average age of the household head, share of subsistence consumption to annual net total income, daily per capita income, land size per capita and livestock value (owned stock) per capita.

Types and patterns of farmer's crop variety and livestock breed selection criteria

The 40-household survey identified seven crops, two types of livestock, that is, sheep and cow (representing 73 crop varieties and livestock breeds), as having been introduced into farmers' field plots since settling in the two research sites.

Table 5 summarizes the number of crop and livestock selection and de-selection episodes per site with percentage in brackets and number of varieties per crop. An identification of smallholder farmers' crop variety and livestock breed selection and de-selection into and out of their farm fields over time is presented in Table 6. It is organized into columns of crops and livestock (ranked



Source: Tada. T (2008).

Map 1. Location of study area: Kamariki sub-location, northeastern slopes of Aberdare.

horizontally in terms of the number of selection episodes) and rows of 5-year periods of selection at the upper part and de-selection at the lower part, plus the accumulated number of households who had settled in the area.

Farmers' perception of the main crop variety and livestock breed selection criteria

During the survey, farmers were asked to evaluate all criteria that the farmers collectively regarded as being important in selecting a variety or breed based on a 1 (strongly agree) to 5 (strongly disagree) response score about the selection criteria. The method allowed a calculation of average (pooled mean) perception score of all the selection criteria for all the households per variety/breed. An attempt was made to understand the criteria that farmers use in crop selection in order of importance by ranking the selection criteria based on the mean score value (Table 7). The case of livestock (sheep and cow) breed selection showing the most important criterion and/or attribute considered by the farmers in their choice is shown in Table 8.

DISCUSSION

Socio-economic characteristics of selected households and study sites

The old age and high education relationship found in Kabendera households is somewhat unexpected and can be explained by the fact that most of the residents of Kabendera are new migrants from original birth places who because of their financial status related to education level were able to purchase their own land unlike in Kiambogo where majority of household heads are young and inherited land from their fathers (original settlers). The adoption of livelihood strategies changes over time and is determined by the life-cycle stage of the household which is related to the age of the household head (Owuor, 2005). The household heads in both sites are

Table 2. Selected household characteristics, August and September 2007 (Mean values).

Village	Kabendera	Kiambogo	Total
Number of the selected households	20	20	40
Age of the household head (years)	52.5	48.3	50.4
No. of years in education: household head	8.1	7.8	7.9
Household size[1]	8.1	6.2	7.1
AEU (adult equivalent units)[2]	6.2	4.5	5.3
Land			
Land owned (acre)	9.6	7.3	8.4
Area farmed (acre)	3.3	3.9	3.6
Land owned per capita (acre)	1.5	1.4	1.4
Area farmed per capita (acre)	0.5	0.8	0.7
Livestock			
Livestock value (Kshs)	94,665.0	62,691.5	78,678.3
Livestock value per capita (Kshs)	15,170.9	11,104.5	13,137.7
Housing amenities			
Age of the house[3]	11.5	9.4	10.5
Estimated value of house[3]	215,625.0	178,230.8	198,862.1
Number of dwelling units	2.2	1.7	1.9
Habitable rooms in main house	3.4	3.1	3.3
Wooden wall (%)	85	95	90
Corrugated iron sheet roof (%)	100	100	100
Earth floor (%)	75	75	75
Energy/fuel (%)			
Firewood as cooking fuel	100	100	100
Charcoal as heating fuel	65	70	67.5
Paraffin as lighting fuel	75	60	67.5
Source of water	River/stream- 50%	Borehole- 45%	NA

Source: August and September, 2007 Survey. [1.]Consists of a person or a group of persons who live, farm, and eat their meals together in the same compound/homestead but not necessarily in the same dwelling unit, have common housekeeping arrangements and are answerable to the same household head whom they all acknowledge as their head, includes both present and absent members such as school attending, remitting, and self-supporting children excluding those married away or with their own households. [2.] AEU: Youth (aged between 12 and 16) counted as 2/3 of adult. Those aged below 12 are excluded. Adopted from Ueda (2007). [3.] Respondents were asked about the year when they constructed their main house and its estimated value as of August/September 2007 according to own valuation.

within the active age cohort of 40 to 59 years with Kabendera having a mean of 52.5 while Kiambogo has 48.3. Official retirement age from the civil service in Kenya is 55 years. The results confirm areal (geographical) differences exist at a local scale in the study sites whereby Kabendera households are more endowed with livestock than those in Kiambogo. This is attributable to the drier condition of Kabendera - a part of the people's strategy to cope with the climatic hardships. On the other hand, Kiambogo farms more area per capita and its agricultural sector contribution to annual net income is considerably greater than that of Kabendera as a result of more reliable rainfall owing to its ecological setting.

The finding that the main house in Kabendera is older and of higher value concurs with that of age of household heads but contrasts the settlements' history. It is expected that, Kiambogo being historically older than Kabendera, should constitute older households which is not the case. This anomaly can be explained by the different system of land management, transition, and inheritance over time whereby most household heads in Kiambogo are heirs (sons) of the initial settlers unlike Kabendera household heads who bought their land by themselves. The value of main house was based on respondents' own valuation and should, therefore be treated with caution for it is not a standardized measure for all the households. Nevertheless, it is informative in household's own perception of one of its important assets. Owing to this limitation, land and livestock

Table 3. Annual net income estimation 2006/2007 (Mean Values for the Selected Household).

Village	Kabendera	Kiambogo	Total
Number of selected households **[Kshs]**[1]	20	20	40
Agricultural[2]	26,596.7	56,547.1	41,571.9
Livestock[3]	35,805.4	26,299.7	31,052.5
Non-farm activities[4]	66,510.0	14,250.0	40,380.0
Off-farm activities[5]	6,175.0	16,545.0	11,360.0
Forest product extraction[6]	14,934.0	31,316.4	23,125.2
Total	150,021.1	144,958.2	147,489.6
Net income per capita[7]	21,769.5	27,359.1	24,564.3
Net income per capita/day	59.6	75.0	67.3

Source: August and September, 2007 Survey.[1]The exchange rate was Kshs: 66 = US$ 1.00 in August 2007. [2] The agricultural sector comprise of all crops cultivated in the two sites. [3] The livestock component includes rearing of cow, sheep, goat, and poultry. [4] Comprise of self-employment in small-scale commerce (shop, *posho* mill, transport services, alcohol brewing), remittances, and formal salaried employment. [5] Includes income from temporary/casual agricultural work on others' land as well as income from *exsitu* (remote land). [6] Refers to income from firewood and timber, poles used by the household. [7] Includes both present and absent members such as school attending, remitting, and self-supporting children excluding those married away or with their own households.

Table 4. Classification of livelihood strategies in Kabendera and Kiambogo, 2006/2007.

Part A: Clustering activity	**Cluster average (%)**				**Total average**
	1	**2**	**3**	**4**	
Agriculture	21.7	17.9	20.9	60.8	31.5
Livestock	9.6	4.9	36.2	8.6	17.1
Non-farm activities	9.4	69.2	18.2	9.2	22.7
Farm activities	8.9	0.6	13.6	1.2	6.8
Forest product extraction	50.4	7.5	11.2	20.2	21.9
Total	100.0	100.0	100.0	100.0	100.0
Dominant activity	Forest	Non-Farm	Diversified	Agriculture	Agriculture
Part B: Cross-tabulation [Number of households]		**Cluster**			**Total**
Village Income strata*	**1**	**2**	**3**	**4**	
Kiambogo					
IV	1		2	3	6
III	2		2	2	6
II		1	3	1	5
I	1		1	1	3
Kabendera					
IV	1	2	1		4
III		2	2		4
II		1	2	2	5
I	4	1		2	7
Total number of households (% in brackets)	9 (22.5)	7 (17.5)	13 (32.5)	11 (27.5)	40 (100)
Other variables					
Average age of the household head (years)	54.8	45.7	52.6	47.1	50.4
Share of subsistence to net total income (%)	29.2	22.9	20.8	16.2	21.8
Daily per capita income (Kshs)	53.6	77.7	71.2	67.2	67.3
Land size per capita (acres)	1.7	0.8	2.0	0.9	1.4
Livestock value per capita (Kshs)	10,299.9	15,465.4	18,497.1	7,644.5	13,137.7

Source: August and September, 2007 Survey. *Net income strata by quartiles (per capita): Kshs; IV: 34,012.75<income; III: 18,356.03<income<=34,012.75; II: 8,263.06<income<=18,356.03; I: income <=8,263.06.

Table 5. Frequency of selection and de-selection episodes in percent (brackets)

Selection	Number of varieties Selected/de-selected by the farmers	Kabendera	Kiambogo	Total
Maize	25	61 (59.2)	42 (40.8)	103 (100)
Potato	13	54 (50.5)	53 (49.5)	107 (100)
Beans	9	64 (71.1)	26 (28.9)	90 (100)
Cabbage	2	1 (16.7)	5 (83.3)	6 (100)
Carrot	1	1 (20.0)	4 (80.0)	5 (100)
Onion	8	35 (61.4)	22 (38.6)	57 (100)
Wheat	2	17 (100)	0 (0)	17 (100)
Cow	10	26 (51.0)	25 (49.0)	51 (100)
Sheep	3	5 (41.7)	7 (58.3)	12 (100)
Grand total	73	264 (58.9)	184 (41.1)	448 (100)
De-selection				
Maize	25	27 (75.0)	9 (25.0)	36 (100)
Potato	13	15 (36.6)	26 (63.4)	41 (100)
Beans	9	18 (90.0)	2 (10.0)	20 (100)
Cabbage	2	1 (100)	0 (0)	1 (100)
Carrot	1	0	0	0
Onion	8	12 (75.0)	4 (25.0)	16 (100)
Wheat	2	2 (100)	0	2 (100)
Cow	10	9 (75.0)	3 (25.0)	12 (100)
Sheep	3	1 (50.0)	1 (50.0)	2 (100)
Grand total	73	85 (65.4)	45 (34.6)	130 (100)

Source: Fieldwork survey 2007 and 2008.

ownership were chosen as supplementary and better indicators of asset endowment for all the households.

Household livelihood strategies, socio-economic stratification and crisis-coping

Differences in agro-ecological setting and altitude, the type of economic activity pursued by the households, history of the settlement, and close proximity to market-trading centers among others result in significant local-regional differences in income portfolios which translate into variable net income distributions across the two sites, as also between the individual households and thus area differences in both livelihood strategies as indicated by the results. For instance, the mean per capita daily income distribution for the interviewed households in Kabendera was lower (Kshs 59.6) than in Kiambogo (Kshs 75.0) and slightly higher than Kenya's absolute poverty line. But, Brown et al. (2006) caution against strict geographic determinism when making inferences about income differentials. As expected, there exists a significant dispersion of household income within and between the two sites. A geographical breakdown of the data was deemed necessary when examining areal differentiation of smallholder livelihoods and the study supported Ueda (2007) view that such differentiation should be substantiated and confirmed at household level. Thus, the study sought to identify distinct livelihood strategies pursued by the smallholders and disaggregated the household level data among such livelihoods. The local level areal differences arising from ecological gradients were manifested in household livelihood differences which in turn determine crop variety and livestock breed selection as a coping and adaptation strategy.

The results on cluster analysis techniques in operationalizing the concept of livelihood strategies using household level data showed how households choose and combine options across the five different sectors of activities already identified. Interestingly, all the four identified livelihood strategy clusters comparatively employed one dominant sector/ activity with percentage contribution to annual net total income being above average and the other sectors/ activities playing a secondary role except for one cluster which was truly diversified. These were referred to as forest product extractors, non farm activity entrepreneurs, diversified livestock keepers and agriculturists. This finding is different from studies which stress rural livelihood

Table 6. Crop variety and livestock breed selection/de-selection over time.

Year of selection	Accumulated number of households existent	Potato	Maize	Beans	Onion	Wheat	Cabbage	Carrot	Cow	Sheep	Total
1960-1965	1	1	1	0	1	0	0	0	1	0	4
1966-1970	1	1	0	0	0	0	0	0	0	0	1
1971-1975	2	2	1	0	0	0	0	0	0	0	3
1976-1980	5	2	4	5	2	1	0	1	5	1	21
1981-1985	9	9	10	12	5	1	0	0	10	2	49
1986-1990	15	17	12	10	4	3	1	0	5	0	52
1991-1995	22	9	12	9	3	0	0	1	4	1	39
1996-2000	33	18	24	26	8	2	0	0	9	4	91
2001-2005	40	37	22	21	14	9	2	1	10	3	119
2006-2008	40	11	17	7	20	1	3	2	7	1	69
Grand total	40	107	103	90	57	17	6	5	51	12	448
Year of de-selection											
1960-1965	1	0	0	0	0	0	0	0	0	0	0
1966-1970	1	1	0	0	0	0	0	0	0	0	1
1971-1975	2	0	0	0	0	0	0	0	0	0	0
1976-1980	5	0	0	0	0	0	0	0	0	0	0
1981-1985	9	2	4	2	1	1	0	0	5	1	16
1986-1990	15	4	2	2	0	0	0	0	0	0	8
1991-1995	22	4	3	0	4	0	1	0	0	0	12
1996-2000	33	4	10	5	8	0	0	0	0	0	27
2001-2005	40	18	10	7	3	0	0	0	3	0	41
2006-2008	40	8	7	4	0	1	0	0	4	1	25
Grand total	40	41	36	20	16	2	1	0	12	2	130

Source: Fieldwork survey 2007 and 2008. Note: The respondents were asked about the crop varieties and livestock breeds they have ever selected and de-selected into and out of their farm fields in a longitudinal manner since their settlement which was also a measure of the frequency of selection episodes.

diversification such as Ellis (2000). Armed with this general view regarding the dominant activity employed, we now turn to the character of the constituent livelihood strategy clusters. The first strategy (Cluster 1) was employed by 9 (22.5%) of the households; 4 from Kabendera and 5 from Kiambogo. The Kabendera households belong to the lowest income strata and were responsible for the clusters' position as the poorest. Agriculture was the second contributing sector towards the annual net income. Cluster 2 was characterized by non-farm activities followed by agriculture. It is not surprising that it was the most affluent in terms of daily per capita income and comprises of younger households drawn from Kabendera (but not Kiambogo) and belonging to high income strata. However it was the least endowed with land resource.

There was no wide variation in contribution of Cluster 3 sectors' activities to annual total net income. It is dominating activity, that is, livestock,

Table 7. Classification, rank and mean score of crop selection criteria by respondents from the research sites.

Code*	Maize (N = 39)	Rank	Mean score	Code*	Potato (N = 39)	Rank	Mean score	Code*	Onion (N = 30)	Rank	Mean score
III	High yield	1	1.91	I	Land/soil type	1	1.92	II	Market opportunity	1	1.60
IV	Taste, nutrition, preference	2	2.10	III	High yield	2	1.95	II	High price (Profitability)	2	1.66
II	Size and/or weight	3	2.28	II	Market opportunity	3	1.96	I	Land/soil type	3	1.77
II	Low labor demand	4	2.28	IV	Taste, nutrition, preference	4	1.96	III	High yield	4	1.81
I	Micro-climate adaptation	5	2.31	II	High price (Profitability)	5	1.99	I	Micro-climate adaptation	5	1.85
I	Drought tolerant	6	2.35	III	Fast maturity	6	2.06	II	Size and/or weight	6	2.06
I	Land/soil type	7	2.40	I	Micro-climate adaptation	7	2.12	I	Drought tolerant	7	2.11
III	Perishability and durability	8	2.52	II	Size and/or weight	8	2.23	III	Fast maturity	8	2.42
III	Pests and disease resistant	9	2.65	I	Drought tolerant	9	2.58	III	Perishability and durability	9	2.77
II	High price (Profitability)	10	2.70	III	Perishability and durability	10	2.62	III	Pests and disease resistant	10	2.81
II	Market opportunity	11	2.71	III	Pests and disease resistant	11	2.71	V	Political-external influence	11	3.02
III	Fast maturity	12	2.94	II	Low labor demand	12	2.75	II	Input restrictions	12	3.13
V	Political-external influence	13	3.26	V	Political-external influence	13	3.46	IV	Taste, nutrition, preference	13	3.15
VI	Trial	14	3.61	II	Input restrictions	14	3.72	II	Low labor demand	14	3.98
II	Input restrictions	15	3.74	VI	Trial	15	4.04	IV	Inherited (Birth place/local)	15	4.13
IV	Inherited (Birth place/local)	16	4.34	IV	Inherited (Birth place/local)	16	4.14	VI	Trial	16	4.26
VI	Fodder for animal	17	4.70	VI	Fodder for animal	17	4.98	IV	Medicinal	17	4.72
V	Government aid	18	4.92	IV	Medicinal	18	4.99	VI	Fodder for animal	18	5.00
IV	Medicinal	19	4.98	V	Government aid	19	5.00	V	Government aid	19	5.00

Source: February and March, 2009 Survey. Notes: 1. The mean score value ranges from 1 (strongly agree) to 5 (strongly disagree) (referring to a question about farmers level of agreement to a statement about the criteria of selection), and was calculated for all varieties grown per crop. 2. It should be noted that varieties were only evaluated by those farmers that planted them shown as N in the Table 3. The codes are used to refer to classification of selection criteria whereby: *Codes: I – Geographic- Environmental; II – Economic-Commercial; III – Agronomic (plant and animal characteristic); IV – Social-cultural and historical; V – Administrative; VI – Others.

was substantiated by large land ownership and livestock value per capita figures. It comprised of the largest number of household membership, 13 (32%) of which eight are from Kiambogo and five from Kabendera. Distribution of these households along the income strata was even. It was rated second in terms of wealth and life cycle in both sites. Finally was Cluster 4 with agriculture being its dominant contributor to annual total net income followed by forest product extraction. The clusters' share of subsistence consumption to net total income as well as livestock per capita value was the lowest. The daily per capita income of this group was almost equal to the less than 1 US$ a day poverty line as previously noted.

Both place-based and household-based understanding of the livelihood strategies available to and undertaken by smallholder farmers at the two sites was provided here. The findings demonstrated that the relationship between livelihood strategies and social-economic status is a function of factors and processes that interact at a given place and time.

Types and patterns of farmer's crop variety and livestock breed selection criteria

The most remarkable thing to note from the results is that maize is the leading crop in terms of number and/or diversity of varieties grown, while Irish potato (referred to as potato in the rest of the paper) leads in number of selection episodes.

Table 8. Livestock breed selection criteria.

Breed name locally	Farmers perception/evaluation of most important criteria/attribute	Score 1 to 5
Sheep		
Doba	Size and/or weight	1.50
Hampshire	Micro-climate adaptation, Market opportunity, high price, fast growth (reproduction)	1.40
Kienyeji	Inherited (Birth place/locally), disease resistant	1.00
Cow		
Arshire	Drought tolerant	2.17
Boran	Drought tolerant	1.00
Freshian	High yield	1.14
Gurnsey	Micro-climate adaptation, milk fat content	1.67
Jersey	Drought tolerant	1.33
Red Bull	Micro-climate adaptation, drought tolerant, low labor, low feeder, disease resistant, inherited	1.00
Sahiwal	Micro-climate adaptation, drought tolerant	1.33
Storia	Market opportunity, High price (profitability), high yield	2.00
Zebu	Micro-climate adaptation, disease resistant, drought tolerant	1.00
Zemento	Milk fat content	1.50

Source: February and March, 2009 Survey.

This is explained by the fact that the two crops form staple food for the residents of the two study sites. The observable site differences can be attributed to local agro-climatic condition of the two sites. A higher frequency of selection and de-selection in Kabendera is an evidence of a greater degree of being affected by economic and climatic changes.

At a descriptive level, the results in Table 6 show that there are more crop and livestock breed selection (448) than de-selection (130) episodes. The influence of in-migration (indicated by the accumulated number of households existent) in determining the number of selection episodes cannot be ruled out, however, it is interesting to note that despite the fact that no new households settled in the area after 2005, the process of selection/de-selection continued unabated. The ordering of crops in terms of selection episodes horizontally reveals a high turn-over in food crops such as potato, maize and beans than in market-oriented crops such as wheat, cabbage and carrot. However, it should be noted that potato is grown for both subsistence and commercial purposes in the two study sites. Further examination of differences among crops reveals a rapid increase in number of selection episodes of more market-oriented crops such as potato (37), onion (14), wheat (9), cabbage (2), and carrot (1) in the period 2001 to 2005 as compared to subsistence crops such as maize and beans. This is a tendency towards market-oriented production system, that is, switch from long maturing to early maturing crops, which can generate income all year round as necessitated by demand for cash income due to inflation pressures and elimination of subsidies as a result of economic liberalization policies.

One way of explaining the emerging patterns of crop and livestock selection/de-selection is by contextualizing them within the external driving forces and/or factors influencing farmers' decision-making in crop and livestock selection. Subsequently, the emerging patterns are substantiated by investigation of a myriad of considerations by farmers in crop and livestock selection/de-selection. There is a multiplicity of selection/de-selection criteria upon which smallholders base their decisions. In the field survey investigation, farmers identified various criteria of crop and livestock selection and de-selection, and these are classified into six broad explanatory factors: Geographic- environmental, economic-commercial, agronomic (plant and animal attribute), socio-cultural and historical, administrative, and others.

Farmers' perception of the main crop variety and livestock breed selection criteria

The inventory of crops grown and livestock kept in the case study sites is representative of the diverse range of ecological conditions, topographical settings, and soil types, prevalent in the area, as well as differences in perception and capability of different socio-economic status of the farmers. Three out of the seven crops identified during the survey, namely maize, potato and onion, are used as case examples to illustrate farmer's perception and/or evaluation of selection criteria. The choice of the three is based on their importance in the agricultural component of the interviewed households' production economy (as well as agro-ecological suitability/adaptability) in both case study sites.

The ranking of selection criteria based on the mean

score value shown in Table 7 confirms differences between the crops arising from farmers' priorities in decision-making with regard to objectives of agricultural production, crop management requirements, processing, consumption and marketing opportunities. The complexity and multiplicity of crop and livestock selection criteria is noticeable in the rankings of Table 7. This means that farmers do not have one criterion of consideration but rather a multiple of selection criteria based on their perception and objectives. In the case of maize, there are no easily identifiable differences in selection criteria groups except for the mean score value of the most important consideration by farmers, that is, agronomic factor of high yield (1.91). This is followed by socio-cultural factor of taste, nutrition, and preference (2.10). The third ranked criteria is economic-commercial, consisting of size and/or weight and low labor demand (2.28) and so on. A look at the mean score values of potato reveals small differences between the most important criteria, land/soil type (1.92) and other criteria such as high yield (1.95), market opportunity (1.96), taste, nutrition and preference (1.96) and high price (profitability) (1.99). These criteria of selection attest to the fact that potato is both subsistence and commercial crop. Apart from the five highly ranked criteria, there are no clear distinctions of the selection criteria groups in potato. It is obvious that farmers evaluate onion on the basis of economic rationality owing to its market-oriented nature as shown by the two most important criteria of selection, that is, market opportunity (1.60) and high price (profitability) (1.66). What is interesting to note is that, in relative terms, farmers do not put a lot of emphasis on agronomic attributes of crops in their crop choice decision-making as the least important/lowly ranked selection criteria group shows. Apart from the most important/highly ranked selection criteria by the respondents, it is almost fruitless to try an interpretation of findings in Table 7. Nevertheless, the information is very useful in illustrating the myriad of factors of consideration by farmers in crop/livestock selection.

The case of livestock (sheep and cow) breed selection shows the most important criterion and/or attribute considered by the farmers in their choice falls under several factors of climate adaptation, economic and commercial viability, socio-cultural influence of inheritance, as well as traits such as disease resistant, milk fat content, body size and weight (Table 8). The analysis from the two case study sites has shown farmers' experiences in coping and adaptation by illustrating the various types and patterns of farmer's crop variety and livestock breed selection criteria. The findings show that there are myriad of factors of consideration that influence crop and livestock selection behavior by farmers.

Conclusion

This study argues that understanding local-level decisions in adoption of different livelihood strategies in the face of changing economic conditions and agro-climatic events should be informed by a holistic approach that revolves around analyses of macro-economic, agro-climatic and historical contexts and local-level processes. The results from the 40 households indicate that areal differences evident in livelihood strategies and crisis-coping experiences are attributable to settlement history, ecological gradient differences, and effects of economic liberalization. The study argues for place-based analysis at both household-level and local-level in enhancing understanding of location-specific context of the human-environment system interaction in which rural livelihoods of smallholders in Kenya take place.

ACKNOWLEDGEMENT

The research was undertaken in collaboration with a main research project by researchers from Institute of Geography and Graduate School of Environmental Studies, Tohoku University. The project was funded by Grant in-Aid for Scientific Research, issued by the Japan Society for the Promotion of Science (JSPS). The author is grateful to the respective institutions for the support and funding.

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